nected at the top of the roof with a turn-cap or louvre, the former being always surmounted with a vane. It is better that the ceiling should be perforated at its centre, and there is no objection to running the ventilating shaft, at first, horizontally, if the perpendicular and terminal portion of it is of considerable length.

8. It is well to have a power of some sort within the apparatus at its top, for the purpose of compelling constant action, and of increasing the force of the apparatus, whenever the state of the weather, or the crowding of the room, renders it necessary. For this purpose, the most convenient and economical means are furnished by a gas burner, an argand lamp, or a stove: and one of these may be in constant readiness for use, when neither the velocity of the wind, nor the low temperature of the external atmosphere, is sufficient to produce the desired effect.

9. All the openings and flues for the admission of pure air, and the discharge of the foul air, should be of the maximum size: that is, they should be calculated for the largest numbers which the apartment is ever intended to accommodate.

10. Valves must be so placed in the flues as to be easily regulated without leaving the rooms into which they open.

11. The best average temperature for schoolrooms is from 64 deg. to 68 deg. Fahrenheit; this range including that of the healthiest climates in their best seasons.

12. For the purpose of summer ventilation, and for occasional use in moderate weather, fireplaces of good size may be constructed in the new houses. They should always be double, and furnished with chambers communicating with the open air.

13. Each story of the building must be warmed by a furnace or stoves, appropriated exclusively for its own use."

They require each room to have a ventiduct discharging itself at the roof, and not connected with any other apartment. These ducts are placed at the part of the room most distant from the ventilating stove, or the opening from the hot-air furnace, and should be constructed if possible in or upon an interior wall or partition. "They should be made of thoroughly-seasoned sound pine-boards, smoothed on the inner side, and put together with 2-inch iron screws. The outside finish may be of lath and plaster." They must be carried entirely to the floor, and should be fitted at the top and bottom with a swivel blind or register, whose capacity is equal to that of the ventiduct into which it opens. This valve is governed by stay rods or pulleys.

A room containing sixty scholars is found to require a discharging duct of fourteen inches in diameter. A room for 100 scholars requires the tube to be 18 inches; and a room for 200 scholars requires it to be 24 inches.

The fresh air ventiducts should exceed in capacity those for carrying off the impure air by about 50 per cent.; so that there will then always be a surplus or plenum supply, and the little currents of cold air which press in at the crevices of the doors and windows will be entirely prevented.

RAILWAY ACCIDENTS AND THEIR PREVENTION.

TRIM OF TRAINS IN TRANSIT.

WE should like to see a full, true, and particular list *now* of the patent and other responses to Fortunatus's 'wish' that 'means of preventing accidents *were suggested* by some one or other, since the directory had failed to discover or invent any worth looking at.' We ourselves have added not a few to the heap in vain accumulated since we uselessly sacrificed upwards of one whole page of our journal at once in sincere response to the insincere 'wish.' The last new 'patent railway signal' is Tattersall's, to be used in such cases as the breaking of an axle, running off the rail, &c. It is chiefly intended to obviate objections to some previous projects of a like order. A box is fitted with a barrel spring, and a cord wound round it is run along the line of carriages, through open rings or hooks in the roof, from the guards to the driver, or rather to a steam whistle on the engine. There is virtually *nothing* new however in this: a correspondent in THE BUILDER long ago suggested nearly the same thing, and it has since repeatedly presented itself with some slight modification or other. Amongst the multitude of suggestions out of which directors might choose, we have seen none to excel, or even to equal our own in matter of fact practicability, and in varied utility, namely, that a freedom of personal movement along a train, on a regular beat, either outside or in, should be afforded to the guards, so that either driver or passenger might be promptly reached on accidental occasion, or at short and appointed intervals. In such a case as that which occurred the other day, when a turbulent, insane, or drunken person presented a pistol at the head of a fellow-passenger, the most prompt aid might thus be afforded; or in cases of sodden insanity which so often and so oddly occur in transit; or in an emergency such as that in which both driver and stoker lay dead drunk on the engine while it was rattling along at the rate of 50 miles an hour, with a coming train on the same line of rail; or, in short, in a multitude of unforeseen circumstances, in which cords and pulleys, or any other means of communication whatever between guards, passengers, and drivers, would either be useless, annoying, or imprudent,—by the simple means alluded to everything necessary could be promptly done, and any intimation to the driver to stop, &c., made by the same mode, *over and above*, as in the case of an axle breaking, or a carriage running off the line, in any part of a train, however short or long, by one or other of the guards or watchmen from either end of the train. This one suggestion, in short, appears to afford a remedy or prevention for a greater number of possible or actual casualties in transit than those offered or afforded by any one suggestion we recollect of, and it is therefore entitled to marked consideration as one of the most economical and useful, as well as practical, amongst the multitude of suggestions heretofore advanced. Perhaps the best possible argument in its favour, and evidence of its prospective utility, is in the fact that in various circumstances, the nearest possible approximation to its rough practice, suggested by necessity or impelled by peril, has been naturally and almost instinctively resorted to by the guards in the dangerous, uncertain, and most unofficial and reprehensible practice of crawling along the tops of the carriages, whereby, nevertheless, as in one case just alluded to, the lives of hundreds were saved from inevitable destruction, though at the double hazard incurred by the very want of a proper gangway or connected line of footboards. Even the other day, too, the practical working of this same rude and perilous substitute naturally displayed itself in circumstances of alarm, arising from the fall of a child out of a carriage in transit. The attention of one of the guards was attracted by an outcry of some of the passengers, and—helpless as his position was, and a mockery his office, to all but a 'guard' possessed of a reckless and ultra-official daring for which the railway management is most blameable, in thus morally compelling its necessity, by not practically obviating it, as they can so easily do—anxiety to ascertain the cause of the outcry, and it may be even fear of the personal as well as other consequences if he hesitated, irresistably prompted this guard also (in the proper and paid-for exercise of his calling was it?) to crawl along the tops of the carriages, in order personally to communicate with the parties sounding the alarm, and then, on thus personally ascertaining the urgency of the case, to cause the driver to stop the train, when instantly measures were taken, by telegraph and otherwise, to prevent the running of other coming trains until the child was found, which it accordingly very soon was, and was restored, too, almost entirely unhurt, to its proper owners. Necessity, therefore, may be said to be at least a helpful foster-mother to the simple invention which we have so perseveringly, but fruitlessly, thrust upon the notice of the public and the proper authorities; and we do hope at length to see either it, or something equally good, and as variously available, if that be possible, brought into practical maturity and general use. This very subject, of the communication between guards and passengers in cases of accident, we perceive, since writing the above, has been brought under notice in the House of Lords, when Earl Granville stated, in reply, that the attention of the Railway Commissioners had been directed at least to the subject of an increase in the number of guards [with reference, we presume, more particularly to additional power over a system of breaks in stopping trains in cases of collision], and that Captain Simmons, one of the inspectors, was instructed to communicate with Captain Huish of the North-Western, with a view to try some experiments. The subject, his lordship added, was one requiring the serious attention of every company, and was still under consideration. The commissioners, however, had no power to enforce any recommendation on the directors, and perhaps it was not desirable, as the responsibility of the latter might thus be, in their estimation, diminished. In fact, we wish his lordship had just hinted the propriety of *increasing* their legal responsibility a little, as we have so often suggested.

STRENGTH OF MATERIALS.

RAILWAY BRIDGES.

AT a late meeting of the Scottish Society of Arts, Mr. George Buchanan read a paper on the strength of materials, and their application in the construction of railway bridges. In regard to cast-iron, the result of extensive experiments was given, and it was found from the mean of sixteen different trials of English, Welsh, and Scotch iron, both hot and cold blast, that this material will sustain about 7½ tons, tensile strain, per square inch of section, before breaking, the weakest specimen being 6, and the strongest 9¾. The limit of fracture, however, can never be approached with safety, not even within a long distance, seeing that this material is liable to unseen imperfections, and, above all, to snap in a moment, without distending itself or giving any warning of danger. Malleable iron, again, is much superior in tensile strength, and by its remarkable ductility, inspires confidence in a still higher degree; it bears no less, on an average, by various experiments of Telford and Brown, than 27 tons—the weakest 24, and the strongest 29 tons—but before the half of this load is applied, it begins to stretch, and continues stretching up to the limits of fracture. It is, therefore, not only three times stronger than cast-iron, but may be safely loaded with five times the breaking weight, or about eight or nine tons.

In regard to the strength of compression, this depends also, as long as the length is limited, on the same element—the section of fracture; but when a long rod or slender pillar is loaded or compressed, it is liable to bend, not for want of strength, but for want of stability, the least flexure turning it off its centre, and breaking it by lateral force, deranging entirely the simple law applicable to short lengths. In regard to cast-iron, by far the most satisfactory experiments are those by Hodgkinson and Fairbairn. The mean result gives very nearly 50 tons on the square inch—the weakest 36½ tons, and the strongest 60 tons. It is thus six times stronger in compression than in distension; and hence it is peculiarly recommended for sustaining any superincumbent weight, as in the case of pillars and of bridges, provided the construction is such as to resolve the strain arising from the load into a longitudinal compression. This is often in our power by proper arrangements, chiefly giving a sufficient height and curvature to the arch; but in cases where, for the want of headroom, the arch is unduly flattened or resolved into a straight beam or girder, the danger is that we bring the tensile force into play, and then the use of cast iron is objectionable, or at least requires extreme caution. No direct experiments have been made on malleable iron of short lengths; but from some facts brought out by Mr. Hodgkinson, its strength appears much inferior to cast iron, chiefly from ductility, whereby it gives way much sooner under a load. It will bear 27 tons, probably much more, without fracture; but with 12 tons it yields to the load, contracts longitudinally, and swells out laterally; and this is another very important fact for our guidance in the use of those different materials. In regard to stone, experiments have been generally made on specimens rather too minute. Like cast iron, the crushing strength is superior to the tensile, and hence its adaptation for building, particularly bridges. Craigleith stone will bear 2¾ tons on the inch, or upwards of 400 tons on the square foot; Aberdeen granite 600 tons. In regard